ESTO

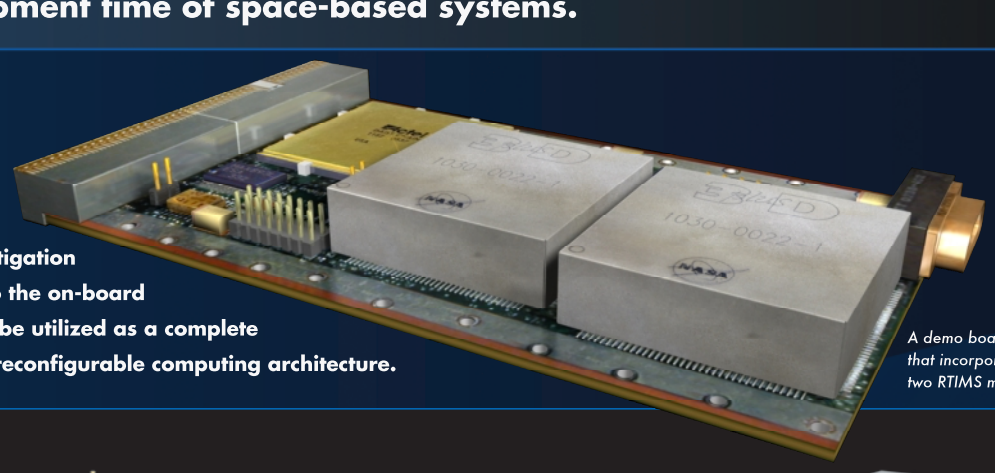
Earth Science Technology Office

RTIMS: Radiation Tolerant Intelligent Memory Stack

Future space missions will require increased resolution, improved data quality, and additional capacity for raw and processed data. This radiation-tolerant stacked memory array, suitable for both geostationary and low Earth orbit missions, can efficiently handle the large data sets of tomorrow, increase the accessibility and utility of data, and reduce the risk, cost, size and development time of space-based systems.

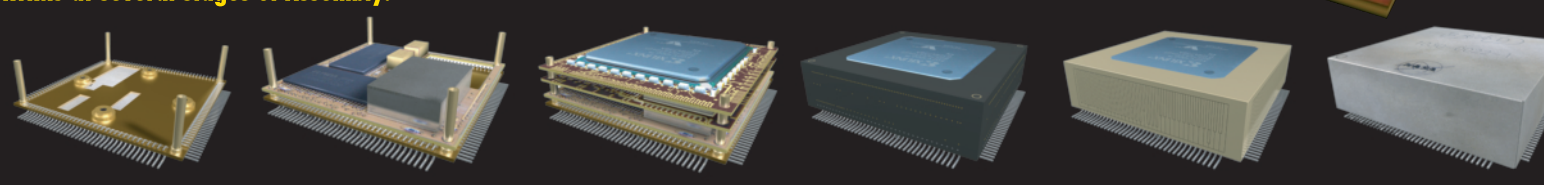
How it Works

RTIMS is a fully tested, in-flight reconfigurable, radiation tolerant, memory array based on novel chip stacking, radiation shielding and radiation mitigation technologies. With computing cores assembled into the on-board field programmable gate array (FPGA), RTIMS can be utilized as a complete computing module that can support a distributed, reconfigurable computing architecture.



A demo board that incorporates two RTIMS modules

RTIMS at several stages of Assembly:



Quad flat package base and heat mitigation pipes

First active layer of components applied

All layers fully assembled

Application of pure epoxy resin molding

Nickel and gold plating connects all flying leads

Final Tantalum shielding

The new construction technology used for RTIMS allows a heterogeneous stack of electronic parts to be built into a single component. A reprogrammable FPGA, six synchronous dynamic random access memories, a linear regulator, and the radiation mitigation circuitries are stacked into a module of 42.7mm x 42.7mm x 13.0mm. The electronic parts in the stack can be bare electronic die, packaged parts (plastic or ceramic), or chip passives (capacitors and resistors). This stacking method provides a significant reduction in mass and size – up to an 80% savings in required volume or footprint.

Radiation tolerance, suitable for GEO and LEO missions, is achieved by using new component-level radiation shielding technology and triple redundancy FPGA techniques. Incorporating radiation mitigation at the component level increases the reliability of the system and effectively eliminates a single point, system wide failure. It also makes design, testing, and validation more efficient by removing the need to design a unique, system-level radiation shield.

The RTIMS module is a major step forward in the state of the art for space based memory arrays. Its features provide advanced functionality and allow standardized hardware to be used for radically different missions, lowering costs and reducing risk.

Features and Benefits

- Low mass (60 grams) and low volume (42.7mm x 42.7mm x 13.0mm) package
- Large memory array (2 Gigabits of error-corrected or 1 Gigabit of triple-redundant digital memory)
- Radiation, thermal, vibration, and lifespan tested
- Reprogrammable Xilinx based controller

Future Applications

- RTIMS modules could be readily incorporated into numerous space-based systems where there is a need for high performance computing applications, real time data processing, reconfigurable computing, or other memory intensive processes.
- The radiation tolerant RTIMS modules are also suitable for high reliability computing and/or data collection at nuclear facilities – specifically for automated or remote controlled nuclear waste handlers – as well as for nuclear powered craft.

Acknowledgments

Team Members:
Jeffrey Herath and Tak-kwong Ng, NASA Langley Research Center
Christian Val and Pierre Maurice, 3D Plus USA Incorporated

Funding by the Earth Science Technology Office (ESTO) through the Advanced Information Systems Technology (AIST) program

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